REMARKS

Claim Rejections - 35 U.S.C. § 103

The Examiner has rejected claims 16, 17, 19-22, 24, 27, 28, and 30 under 35 U.S.C. §103(a) as being unpatentable over *Mertol* (US 6,008,536) and further in view of *Miyao* (JP4-364764) and *Nagesh* (US 5,585,671).

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Response to 35 U.S.C. § 103 rejections

With respect to the rejection of claims 16, 17, 19-22, 24, 27, 28, and 30 under 35 U.S.C. §103(a) as being unpatentable over *Mertol* and further in view of *Miyao* and *Nagesh*, applicant submits that the present claims are patentable in view of *Mertol*, *Miyao* and *Nagesh* since these references all fail to disclose at least an element of the present claims, namely a thermal interface material comprising an electroactive polymer covalently bonded to a heat dissipating device and/or the heat generating device.

The present claims disclose an apparatus comprising a heat dissipating device and a thermal interface material wherein the thermal interface material comprises an electroactive polymer covalently bonded to the heat dissipating device and/or the heat generating device. Covalent bond is a chemical bond between atoms where a number of valence electrons are shared between these atoms. An example of covalent bonds is the bond between an oxygen atom and a hydrogen atom (such as in a water molecule) where an electron from oxygen atom and an electron from

hydrogen atom are shared and contributed between the two atoms. Another example of covalent bonds is the bond between a hybrid polymer having an electroactive end group such as COO^- and a substrate (metal or silicon) surface (Paragraph [0022]). The electron of the O^- atom in the COO^- group is shared with an atom in the surface, forming a covalent bond of the polymer atom with the substrate surface atom.

Covalent bonding may result in stronger bonding between atoms and molecules which may result in more effective heat transfer than may be possible using traditional methods that rely on physical contact for heat transfer. Thus the formation of the covalent bonds can reduce the thermal resistance across the interface of the heat dissipating device and the thermal interface material. Covalent bonding of the thermal interface material with the heat dissipating device can be achieved by electrodeposition of an electroactive polymer.

Applicant submits that *Mertol*, *Miyao* and *Nagesh* all are silent with respect to a covalent bonding of the thermal interface material with either the heat generating or the heat dissipating device. *Mertol* discloses an integrated circuit 12, a thermal interface layer 36, and a heat spreader 16. However, *Mertol* is silent as to the presence of covalent bonds between the thermal interface layer and the heat spreader.

Miyao discloses a heat sink 7 as a heat dissipating member on the rear surface of a circuit board 1 by an adhesive. However, *Miyao* is also silent as to the presence of covalent bonds between these materials.

Nagesh discloses a ceramic substrate having a polar oxide surface bonding with an opposite-polarity epoxy lid attach material. The ceramic substrate has a layer of black iron oxide, providing the polar oxide surface. The epoxy lid has an opposite polarity, and the two materials are bonded with good adhesion and near-hermetic seal (Col. 5, lines 52-56; Col. 6, lines 4-12).

However, applicant submits that the bonding between the iron oxide and the epoxy is the result of <u>electrostatic attraction forces</u> between <u>molecules</u> (polar iron oxide and polar epoxy), and not the <u>sharing of valence electrons</u> between <u>atoms</u> as defined in covalent bondings.

Since the electronegativity of oxygen atom is higher (3.5) than that of iron (1.6), the distribution of electrons in iron oxide is polar, meaning the electrons spend more time near the oxygen atoms than near the iron atoms. Iron oxide is thus a polar molecule, having a multi-pole shape with the oxygen atoms having negative poles and the iron atoms positive poles. However, the electrons are confined within the iron oxide molecules, not sharing with the epoxy molecules. And the interaction of the iron oxide with the polar epoxy is the electrostatic attraction between the charges of the polar iron oxide and the opposite-polarity polar epoxy, not the covalent bonding between atoms.

The examiner stated that the oxidizing step of *Nagesh* would have been expected to create covalent bonds between the epoxy interface material and the iron heat spreader. Applicant respectfully disagrees. The oxidizing step of *Nagesh* simply creates a charged polarized surface for the iron heat spreader. The iron oxide charged-polarized surface is then attracted to the charged polarized epoxy surface due to electrostatic force. The bonding between the epoxy interface material and the iron heat spreader can be considered as a macroscopic interaction between the two charged-polarized surfaces. Applicant submits that this bonding is not a covalent bonding, which is the sharing of electrons between atoms, and occurs at a microscopic scale.

Thus applicant submits that *Nagesh* fails to disclose a covalent bonding between the thermal interface material and a heat generating and/or heat dissipating device.

In sum, applicant submits that the present claims are patentable in view of *Mertol*, *Miyao* and *Nagesh* since these references all fail to disclose at least an element of the present claims, namely a thermal interface material comprising an electroactive polymer <u>covalently</u> bonded to a heat dissipating device and/or the heat generating device.

With respect to the rejection of claims 16, 17, 19-22, 24, 27, 28, and 30 under 35 U.S.C. § 103(a) as being unpatentable over Smith and further in view of *Miyao* and *Nagesh*, applicant submits that the present claims are patentable in view of *Smith*, *Miyao* and *Nagesh* since these references all fail to disclose at least an element of the present claims, namely a thermal interface material comprising an electroactive polymer <u>covalently</u> bonded to a heat dissipating device and/or the heat generating device.

Smith is silent with respect to a covalent bonding of the thermal interface material with either the heat generating or the heat dissipating device. And as discussed above, both *Miyao* and *Nagesh* all fail to disclose a covalent bonding of the thermal interface material with either the heat generating or the heat dissipating device. Thus the present claims are not obvious in view of *Smith*, *Miyao* and *Nagesh*.

Other claims are dependent claims, thus should be allowable, at least for the reason stated above with respect to the independent claims.

<u>Claim Objections</u>

The Examiner has objected to claims 18 and 29 as being dependent upon a rejected base claim, but would be allowable if re-written in independent form including all of the limitations of the base claims and any intervening claims.

Response to claim objections

Applicant appreciates the allowance of claims 18 and 29, and respectfully request allowance of other claims.

As such, Applicant respectfully requests the removal of the 35 U.S.C. § 103 rejections of claims 16, 17, 19-22, 24, 27, 28, and 30 and seeks an early allowance of these claims.

Pursuant to 37 C.F.R. § 1.136(a)(3), applicant(s) hereby request and authorize the U.S. Patent and Trademark Office to (1) treat any concurrent or future reply that requires a petition for extension of time as incorporating a petition for extension of time for the appropriate length of time and (2) charge all required fees, including extension of time fees and fees under 37 C.F.R. §§ 1.16 and 1.17, to Deposit Account No. 02-2666.

Respectfully submitted,

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